NOTES ON THE LIFE HISTORY AND ANATOMY OF SIPHONA PLUSIÆ Coq.

By William Bloeser, Stanford University, Calif.

LIFE HISTORY.

The Tachinid fly, *Siphona plusiæ*, was described by Coquillet in 1897. It was bred from a cut-worm. The specimens that I have obtained, however, were parasitic in the larvæ of *Phryganidia californica*, gathered from oak trees at Stanford University.

The Phryganidians were more than plentiful during the fall of 1913, and consequently there was an abundance of parasites. *Siphona* is only one among a dozen or more parasites that are nursed in their infancy by the accommodating Phryganidian, but notwithstanding the ravages of all these parasites, and the scourge of a fungus disease, which killed nearly one third of the caterpillars, there were still many left, sufficient to insure a great number of moths again in the following spring.

The following notes on *Siphona plusiæ* are the result of observations made in the fall of 1913:

The Egg. The adult female fly lays one or more eggs on the outer body wall of the Phryganidian larva. The dipterous parasites are not as careful as the hymenopterous parasites, and they lay their eggs indiscriminately, often laying three or four eggs on one host.

The Larvæ. After the eggs have hatched the young larvæ make their way into the body cavity of the Phryganidian, where they remain from ten days to two weeks, feeding on their host until fully grown, when they measure about five-sixteenths of an inch in length. They have eleven segments; well developed mouth parts, in the form of great hooks; two large posterier spiracles and two smaller anterior ones.

The larvæ are loosely attached or held in a sort of cicatrix, in the body of the host, by several rows of small hooks that encircle the tenth and eleventh segments. From this position the head and anterior portion of the body are free to swing in the body cavity. Some larvæ are found, however, moving

about freely in the body cavity, while those that were attached could be easily removed or could themselves change their position.

About one hundred Phryganidia were dissected and ten *Siphona* parasites were found, three of these being taken from a single caterpillar. It would be hard to estimate with much accuracy the probable percentage of parasites, but ten per cent, I believe, would not be too high an estimate.

Some of the Phryganidia were kept alive in a cage, and from these there issued several fly larvæ, which pupated in about two hours. In no instance did the parasites issue from Phryganidia pupæ, but all seem to leave the Phryganidia while the host is still in the larval stage. After freeing itself from the host the larva soon begins the period of pupation. It begins by drawing itself together and changing to a darker color, and within a couple of hours it is a brown segmented pupa about three-sixteenths of an inch in length. One pupa remained from the sixth of October to the twenty-fourth, a period of eighteen days, before the imago finally appeared. Other larvæ were alllowed to pupate, but from eight pupæ only the one fly issued, while from the seven others, there issued hymenopterous hyperparasites, which have not yet been determined. These issued somewhat later, taking twenty-three to twenty-five days to come from the pupa cases.

This percentage of hyper-parasites is almost certainly more than the average, as they came from Phryganidia that were gathered from a single oak tree situated in a flower garden. It is to be hoped that further investigation will reveal a smaller percentage of hyper-parasites, as their abundance will greatly check the beneficial work of *Siphona plusiæ*, which has so greatly aided in controlling the Phryganidia in California, especially in the Santa Clara Valley.

The Adult. The adult has been described by Coquillet,* but practically nothing of the life history has been heretofore given. The general characteristics of the adult are shown in text-fig. 2, a special character being that the proboscis has two geniculations, one near the base and the other near the middle.

* Canadian Entomologist, Vol. 27, p. 125.

ANATOMICAL NOTES.

External Appearance. The larvæ are white and nearly translucent, and the colors exhibited are at either end. The great hooks (text-fig. 1) which form the most important part of the mouth structure, are jet black. On the last segment there are two large posterior spiracles, which are of a deep brown color. There are also several rows of little dark colored hooks around the tenth and eleventh segments (text-fig. 1).

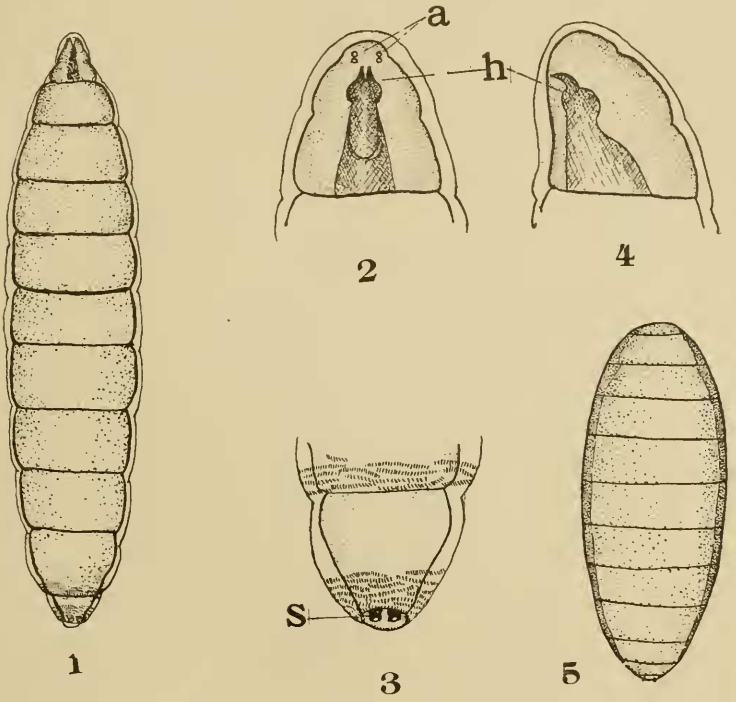

Fig. 1.

1. Dorsal view of full grown larvae.
2. Ventral view of first segment; a, antennae (?); h, great hooks.
3. Dorsal view of last two segments, showing rows of little hooks and s, posterior spiracles.
4. Lateral view of first segment; h, great hooks.
5. Dorsal view of pupa.

The opening of the two large tracheæ at the anterior end are less plainly visible. The main tracheal trunks narrow towards the head, and each branches out into two fine tubes which terminate in small spiracular openings at about the beginning

of the second segment. These, however, disappear after the larva has made two or three moults, and there are no longer any anterior spiracles.

At the extreme tip of the first segment, on either side of the great hooks, there is a pair of wartlike processes, as shown in text-fig. 1. These are probably rudimentary antennæ.

Internal Anatomy. The alimentary canal and Malpighian tubules, (shown in Plate XL, Fig. 1.) are quite characteristic, in their many turns and loops, of Dipterous larvæ in general, especially those of the Muscid kinds. The parasitic life of the larva seems to have resulted in no considerable structural modification of the digestive system.

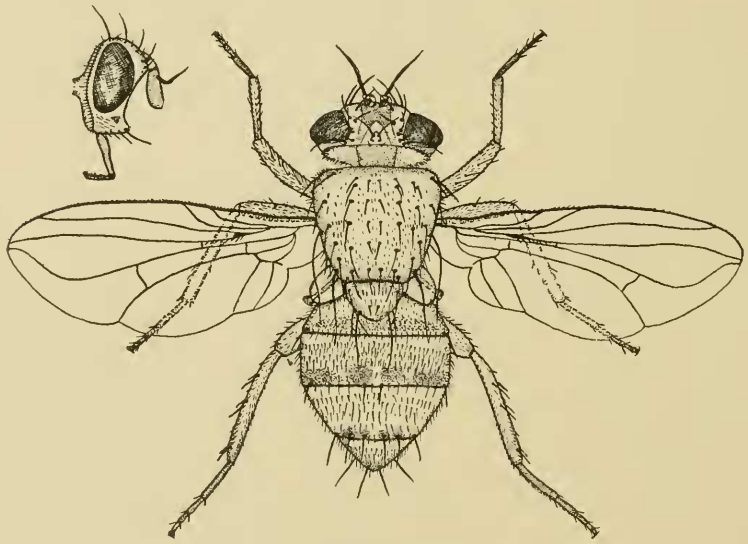

Fig. 2.

Adult fly, dorsal view, showing general characteristics; also lateral view of head, showing proboscis with two geniculations, one near the base and the other near the middle. (Greatly enlarged).

The oesophagus, starting at the mouth, extends backward as a narrow cylindrical tube, passing through the supraœsophageal ganglia, or brain, and then passing above the ventral ganglion and entering the proventriculus, which lies in about the fourth segment of the body. From the proventriculus, the mesenteron, or portion of the canal from the proventriculus to

the Malpighian tubules, is a nearly uniform tube of considerable size, the anterior portion being the chyle stomach and the posterior portion, the intestine.

The Malpighian tubules in this insect are particularly interesting in regard to their position in the body cavity. They arise from the alimentary canal, as shown in the drawing, as two lateral tubes, each of which divides into two tubes. The two from the right side swing forward and the two from the left side run towards the posterior end. This is somewhat different from what would be expected, and is a departure from the general rule. The usual number of tubes is four in the dipterous larvæ, but all four either turn and run posteriorly, keeping to their respective sides, as in the blow fly, or else the right and left branch, each sending one tube forward and one backward.

The portion of the alimentary canal from the entrance of the Malpighian tubules to the anus is the metenteron. This portion is considerably smaller and shorter than the mesenteron and has a thick muscular coat.

The dorsal blood vessel or heart; the tracheal system; the nervous system, and the salivary glands, are shown in plate XL, Fig. 2.

The heart is a thin-walled muscular tube which extends nearly the length of the body, lying in the pericardial cavity just beneath the dorsal wall. It tapers from a good-sized sac to a fine tube as it runs forward.

The tracheal system is composed of two main trunks with large spiracles opening on the posterior segment. Branches are given off from the two main trunks at each body segment and these finer tubes wind in about the alimentary canal. The anterior spiracles are wanting, except in the very young larvæ.

The salivary glands, which extend from the mouth, starting as a single narrow duct, branch out beneath the pharynx and extend, one on either side of the alimentary canal, for more than a third of the length of the body.

The brain and body ganglion, shown in the same figure, compose the nervous system of the larva. The hemispheres encircle the oesophagus just forward of the proventriculus, and the main body of the body ganglion extends backward on the ventral side nearly the same distance that the salivary glands extend on the lateral sides.

The muscles and fat cells are conspicuous, but do not differ particularly from those of other dipterous forms.

I limit my description of the anatomy to the fewest words possible, as the figures and plates tell the story sufficiently. The interesting thing about the anatomy of the larva is that it is so little different from that of any free-living, outside-feeding dipterous larva of Muscid type. Either the parasitic habit makes no less demands on alimentary canal, respiratory, circulatory and secretory systems than the free life habits, or this insect has so recently adopted a parasitic habit that no considerable structural changes in its organs have yet been brought about in connection with it.

This paper was prepared in the Entomological Laboratory of Stanford University.

EXPLANATION OF PLATES.

Abbreviations used:

Antennae	a	Metenteron	Y
Anus	A	Muscle	L
Brain	B	Body Ganglian	N
Fat Cells	F	Oesophagus	O
Great Hooks	h	Proventriculus	P
Heart	H	Salivary Glands	G
Imaginal Discs	I	Spiracles	S
Malpighian Tubules	M	Trachae	T
Mesenteron	X		

PLATE XXXIX.

Cross sections through larvae.

Fig. 1. Section through anterior portion, about the second segment; T, trachea; I, imaginal discs; G, salivary glands; O, oesophagus; L, muscles.

Fig. 2. Section through neuroblast, about the third segment; H, heart; T, trachae O, oesophagus; B, brain; N, sub-oesophageal ganglion; G, salivary glands.

Fig. 3. Section through proventriculus, about the fourth segment; H, heart; F, row of fat cells; T, trachea; P, proventriculus; N, ganglion, G, salivary glands.

Fig. 4. Section through many folds of the alimentary canal, about the fifth segment; H, heart; T, trachea; M, Malpighian tubules; C, alimentary canal; L, muscles.

Fig. 5. Section showing Malpighian tubules branching from alimentary canal, about the eighth segment; H, heart; T, trachea; M, Malpighian tubules; C, folds of alimentary canal.

Fig. 6. Section near posterior end; T, trachea; M, Malpighian tube; C, alimentary canal; A, anus.

PLATE XL.

Fig. 1. Horizontal longitudinal view of larva, showing, O, oesophagus; P, proventriculus; X, folds of the mesenteron; Y, the metenteron; M,anterior and posterior Malpighian tubules.

Fig. 2. Vertical longitudinal view of larva, showing, S, spiracle; G, salivary glands; B, brain; N, ganglion; F, row of fat cells; T, trachea; H, heart; L, muscles.